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BUILDING STANDARD IN COMOS

Tekniikka ja liikenne
2010

VAASAN AMMATTIKORKEAKOULU

Kone- ja tuotantotekniikan koulutusohjelma

TIIVISTELMÄ

Tekijä	Juha Rintalahti
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Ohjaaja	Juha Hantula

Tämä päättötyö tehtiin Wärtsilä Finland Oyj Power Plants yksikölle. Tarkoituksena oli tehdä standardistruktuuri Comos-ohjelmalle joka oli suunniteltu korvaamaan nykyiset ohjelmat. Tavoite oli tehdä siitä mahdollisimman käyttäjäystävällinen Wärtsilän työntekijöille, asiakkaille ja alihankkijoille.

Päättötyön tekeminen alkoi Comos-ohjelmaan, sekä siihen liittyviin integraatioihin, kuten *databaseen* ja dokumentin hallintasysteemiin tutustumisella. Nämä systeemit ovat kriittisiä osatekijöitä struktuuriin perustuvaa standardia tehtäessä. Työ jatkui erilaisten menetelmien testaamisella. Tähän sisältyi struktuurin rakenne ja datan siirtomenetelmät ohjelmistojen välillä.

Lopputuloksena saatiin toimiva *Way Of Working*, joka todettiin käyttötarkoitukseen sopivaksi, sekä luotiin toimiva struktuuri ohjelmaan. Integraatio IDM:än ja Comoksen välillä saatiin toimimaan, myös osalistojen tiedonsiirto toimi suunnitellusti. Wärtsilä päätti, ettei Comosta oteta käyttöön Power-Plants – yksikössä, joten tämän päättötyön lopputulos oli käyttökelpoisen tiedon saaminen siitä mikä meni hyvin ja missä olisi vielä parantamisen varaa. Tätä informaatiota tullaan käyttämään myöhemmin vastaavanlaisissa ohjelmistokehitysprojekteissa.

Asiasanat Comos, ohjelma, IDM, standardi, struktuuri

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ABSTRACT

Author	Juha Rintalahti
Title	Building Standard in Comos
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Name of Supervisor	Juha Hantula

This thesis was made for Wärtsilä Finland Oy compartment of Power Plants. The purpose of this thesis was to make Standard Structure for Comos program which was planned to replace the current programs. The aim was make it as user-friendly as possible for Wärtsilä users, customers and sub-suppliers.

The work for the thesis started by getting to know the Comos program and all integrations for databases including document handling systems which are critical parts for making a structure based standard. It continued as testing different methods for making structures and data transferring methods.

As a result, a usable *way of working* and suitable structure was made. Integration between IDM and Comos was made to work as planned as well as Device Lists data transferring. Wärtsilä preferred not to use Comos in Power Plant as a main design tool program and therefore the final result of this thesis was to get useful information as to what went correctly and what did not. This information can be used for later program developing projects.

Keywords Comos, program, IDM, standard, structure

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Backround

I started working summer trainee in Wärtsilä 2004 as an assembly worker. I was looking for thesis topic late in 2007. In summer 2008 I finally got opportunity to start working in Power Plants runsor office and got thesis topic related my work with Comos.

1.2 Definition of thesis

Comos was choosed to main program for certain type of work in Wärtsilä. It wasn't clear what kind of structure was best for users, developers, databases and document handling systems (Figure 1). This bachelor's thesis purpose was make this structure for Wärtsilä needs. Structure is what user sees in program menu. This is critical part of making new program for wider use.

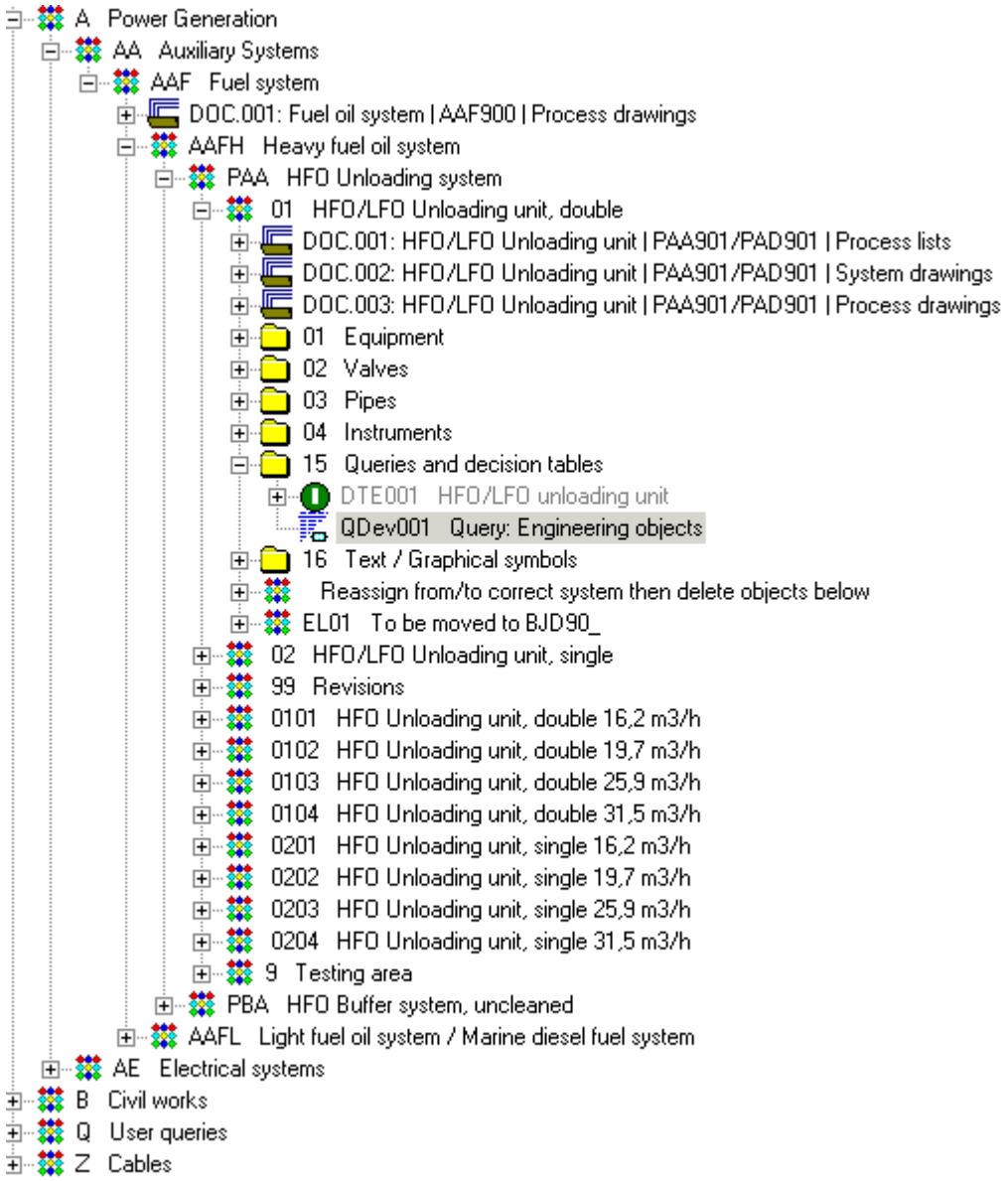

Figure 1 show typical structure in Comos.

2 COMPANY

2.1 Wärtsilä Finland Oyj Abp

Wärtsilä is a global leader in complete lifecycle power solutions for the marine and energy markets. By emphasising technological innovation and total efficiency, Wärtsilä maximises the environmental and economic performance of the vessels and power plants of its customers.

In 2009, Wärtsilä's net sales totalled EUR 5.3 billion with 18,000 employees. The company has operations in 160 locations in 70 countries around the world. Wärtsilä is listed on the NASDAQ OMX Helsinki, Finland.

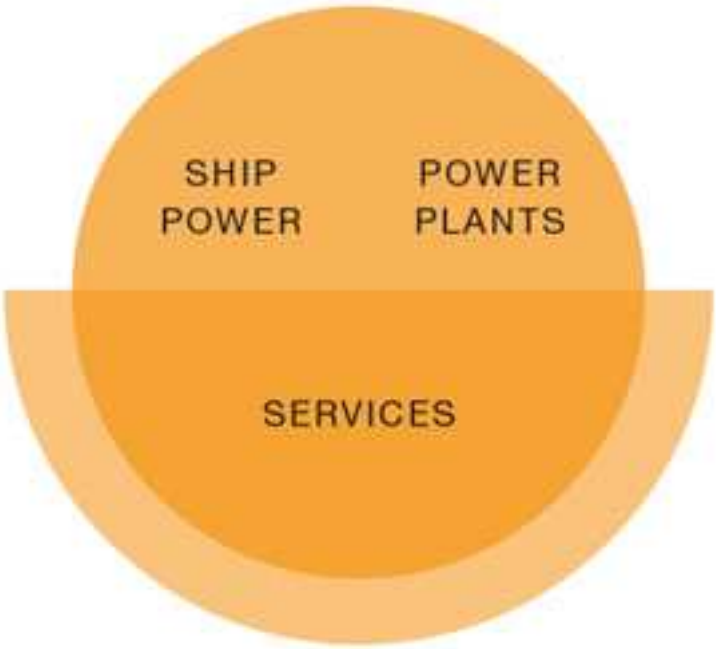

Figure 2 Group structure

2.2 Power Plants

Wärtsilä is a leading supplier of flexible power plants for the decentralised power generation market. We offer solutions for baseload power generation, grid stability & peaking, industrial self-generation as well as for the oil and gas industry. Technology leadership, a strong and broad product portfolio, high efficiency and fuel flexibility, plus the ability to offer complete turnkey

deliveries worldwide puts us in a unique position in the power plants markets.

2.3 Ship Power

Wärtsilä is the leading provider of ship power solutions including engines, generating sets, reduction gears, propulsion equipment, automation and power distribution systems as well as sealing solutions for the marine industry. Our customer are the global or local leading companies within the merchant, offshore, cruise and ferry, navy and special vessel segments. We command a strong position in all main marine segments as a supplier of highly rated ship machinery and systems.

2.4 Services

Wärtsilä supports its customers throughout the lifecycle of their installations by optimizing efficiency and performance. We provide the broadest portfolio and best services in the industry for both ship power and power plants. We offer expertise, proximity and responsiveness for all customers regardless of their equipment make in the most environmentally sound way.

3 COMOS IN SHORT

comos is a software that has been developed and supplied by a German company Innotec.

Comos is Computer Aided Engineering (CAE) tool that will be used for:

-Designing process & instrumentation diagrams and creating related reports

-Designing electrical and automation drawings and creating related reports

Comos is a very open program that is fully customizable.

Data and documents from Comos can be exported to other formats:

Excel, Word, XML, DXF, DWG and PDF.

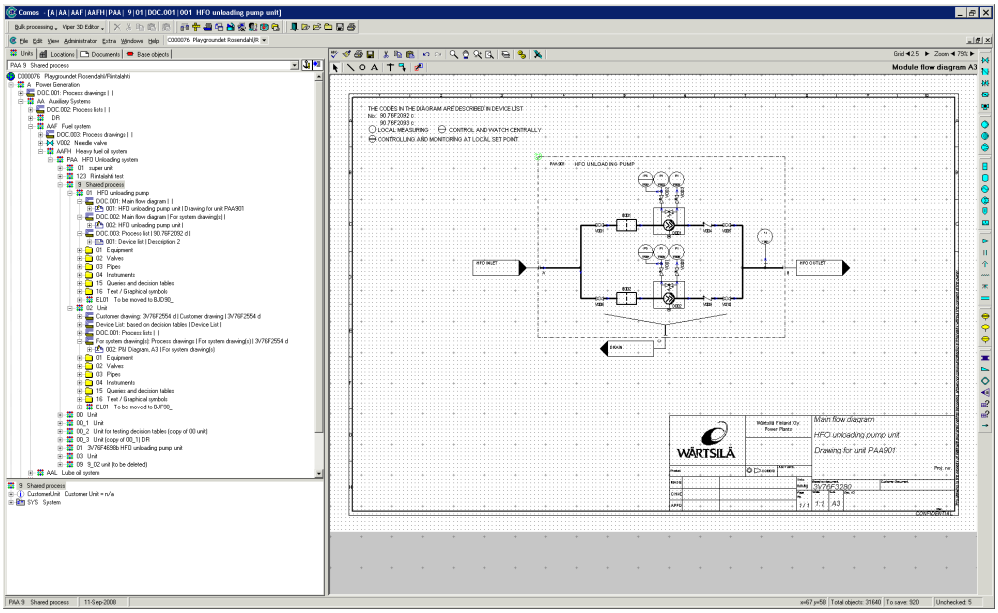

Figure 3 show typical view for main window

4 COMOS IN WÄRTSILÄ

A pilot project to a new tool for P&ID and automation and electrical design was launched by Wärtsilä Power plant and CITEC in 2003. Later that year Wärtsilä Ship power joined that pilot project, when the wider usage possibilities of COMOS were recognized (Figure 4).

Business	Country	Business area
Power Plants:	Finland	
Ship Power:	Finland	4-stroke
	The Netherlands	Propulsion
	Norway	Propulsion, (Automation)*
	Italy	4-stroke
	Switzerland	2-stroke
Engine Division:	Finland	4-stroke
	Italy	4-stroke
	Switzerland	2-stroke

Figure 4 show Comos units in Wärtsilä

Comos pilot project ended in the beginning of year 2006 with the conclusion that Comos can fulfil the requirements for Wärtsilä needs and can be used for Wärtsilä businesses globally. At the end of 2006 when project was kicked off, detailed requirements were globally collected and scope for needs was finalised.

Plan for project execution approved by 12/2006 and January 2007 this project building started in full speed. In June 2007 Comos Key-users was able to start creating standard design libraries for Comos.

5 THE GOAL FOR COMOS PROJECT

The project scope was divided into following areas.

- INFRASTRUCTURE

Delivering needed hardware and supporting software that enables usage of COMOS as defined in the requirements

- COMOS

All COMOS programming, scripting and configuration needed to build required functionality

- DATA

Choosing what master data is to be inserted to COMOS database and creating needed data in the system

- WOW:

Defining the process related to working with COMOS and making sure that needed guiding documentation is created and attached to the process that described the way of working

- COMOS-WDMS

Building integration between COMOS and 4-stroke/2-stroke WDMS solution so that it fulfils agreed requirements.

- COMOS-IDM

Building integration between COMOS and IDM so that it fulfils agreed requirements.

- COMOS-TEAMCENTER

Building integration between COMOS and IDM so that it fulfils agreed requirements.

- SUPPORT

Defining and setting up the support structure and organisation for COMOS.

The purpose for Comos was replacing the old way of working, which was shown to not meet requirements for Wärtsilä needs. One common tool for multiple usages was the main reason for choosing Comos. Replacement planned to replace at least IDOK, ELSA, Medusa, AutoCAD, excel etc.

Also the new way of working will enable different businesses to reduce amount of double work for mainly because Mechanical and Electrical design is integrated in Comos.

Using Comos will enable of common symbols, coding, language and drawing templates and improve the communication between partners/customers and enable uniform look and feel towards customers and Wärtsilä partners. This is possible when global database is properly working as planned.

Increasing system availability and easier user support is better, because Comos can be used over internet.

Saving money was one of the main goals as well. Using Comos P&ID and Electrical design has shorter creating time and template project is easy to make and use.

Comos will be used to create above designs and documents.

6 USING COMOS IN WÄRTSILÄ

1. Customer opportunities (sales projects). One Comos project per type of offered solution. Sales to a totally new opportunity or further sales to an existing installation.

2. Customer installations (delivery projects). One Comos project per one installation. One installation = one ship or one power plant. One installation = One functional location number in SAP. Sold solution planned during sales project in Comos used as starting point.

3. New product & solution development (R&D projects) One Comos project for one R&D development project.

The document types that will be created in Comos

1. Process drawings and reports:

Process & Instrumentation diagram

Main Equipment List

Device list

2. Electrical drawings and reports:

Wiring diagram

Panel wiring diagram

Single Line diagram

Cable overview diagram

Electrical Block Diagram

Electrical Panel - Parts list

Electrical Panel - Cable list

Electrical Panel - Terminal Plans

Electrical Panel - List of nameplates

Electrical Panel - Circuit Diagrams

Electrical Panel - Design diagram

Monitoring Point List

Electrical consumer list, DC

Electrical Consumer list, AC

PLC I/O list

Hardwired I/O list

Hardwired alarm list

7 STRUCTURE

7.1 System structure

The unit structure in Power Plant Standard design project is build up as presented in the figure 5.

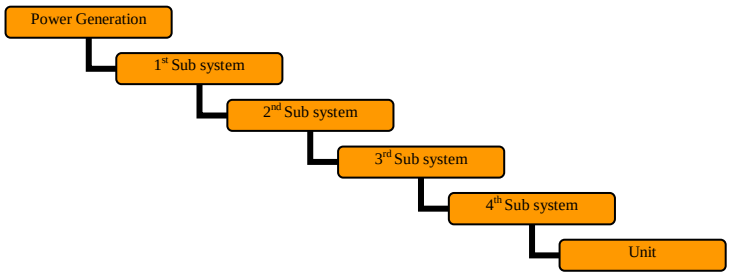

Figure 5 Show the Power Generation structure

Units are stored under the fourth sub system. Unit 01, 02 … are the base units. This system contains unit 01's and 02's different structures and lists, which are created when running the decision tables.

There can be several alternatives for these base units. The base unit is the main unit, where all design and component changes are made. Those alternatives are stored as unit 0101, 0102…0201, 0202 etc (Figure 6).

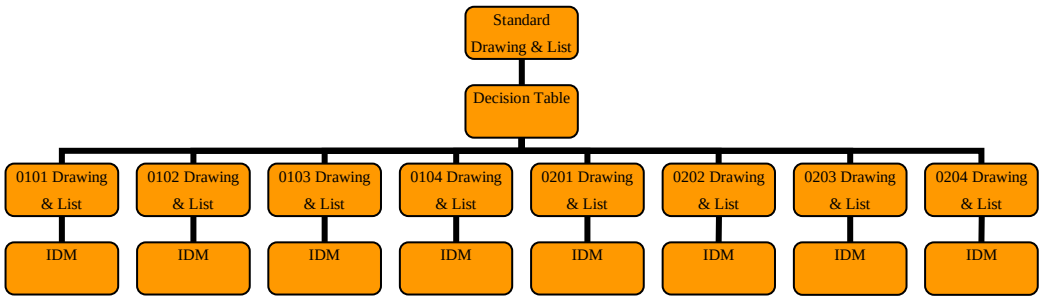

Figure 6 shows how drawings, lists and tables are placed in IDM

An alternative unit contains standard drawings for IDM (also to be copied to Comos standard library called S01), structure with general symbols only and decision table, which will tell the component data.

Alternative units are created as a copy of 01...02 units. To alter the base unit's component data, decision table is executed (Figure 7).

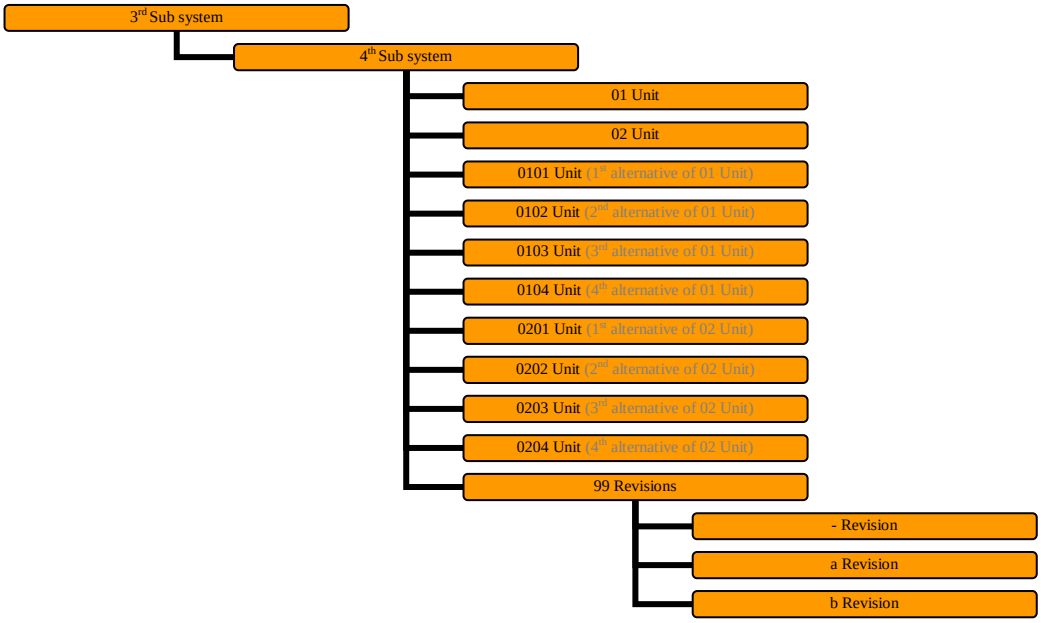

Figure 7 show system structure

Revision unit is reserved for future reference where placed older revisions. It's called as *99 Revision*. This folder contains – *revisions, a revision, b revision* etc.

7.2 Unit structure

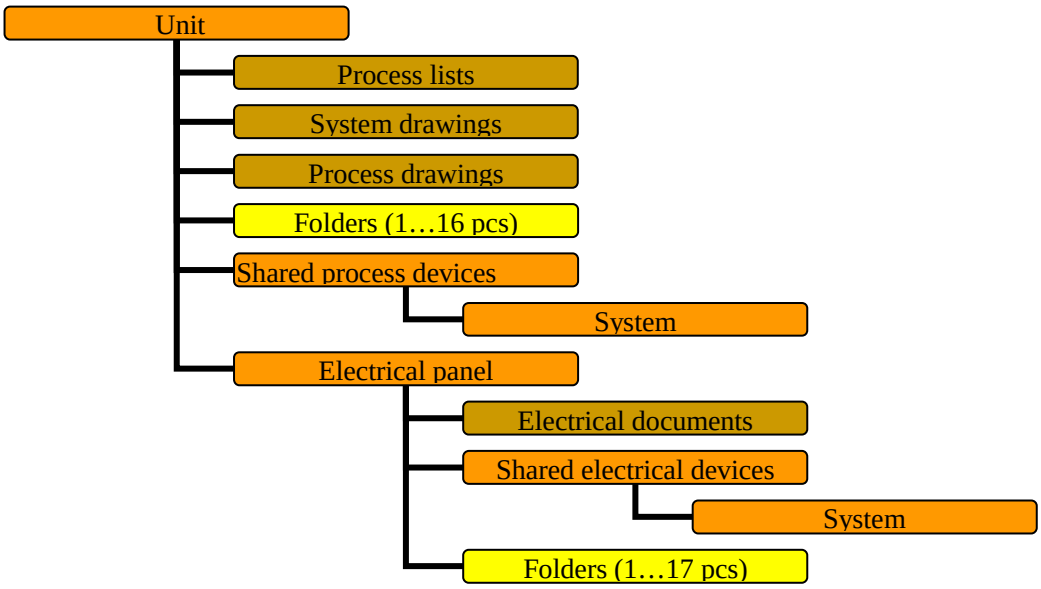

Figure 8 show structure of unit level

Each unit in standard structure contains one Electrical Document Package for Electrical documents and 3 Process document packages, 2 for drawings; one for device list package (Figure 8).

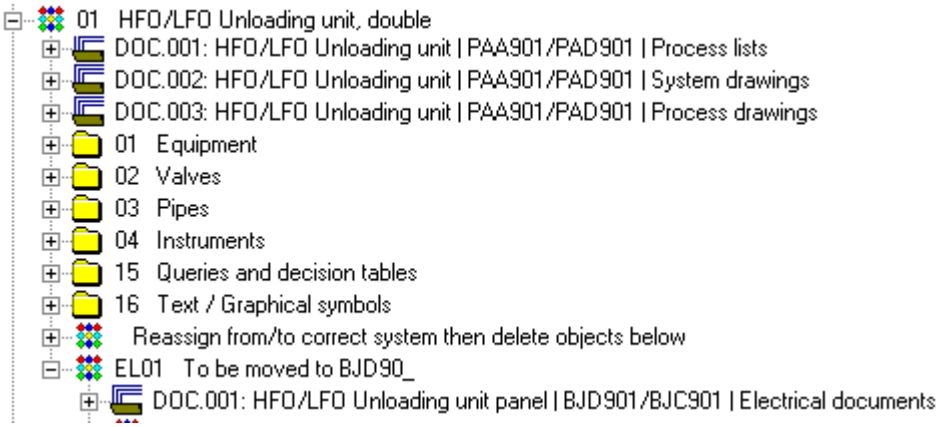

Figure 9 Shows example of Document Package structure.

Electrical structure contain *"Reassign from/to correct system then delete objects below" (@U1)* and *"EL01 To be moved to BJD90_"* folder. Below this unit come Electrical Document Package (Figure 9) and 3 units, which are *01 To be moved to BFA/901, 03 To be moved to CFC0_1* and *04 To be moved to Z cables*. Those units contain needed panels, switches etc.

Electrical Document package is named as *HFO/LFO Unloading unit panel*. Document package Description 2 is *BJD901/BJC901* and Description 3 is *Electrical documents* (Figure 10).

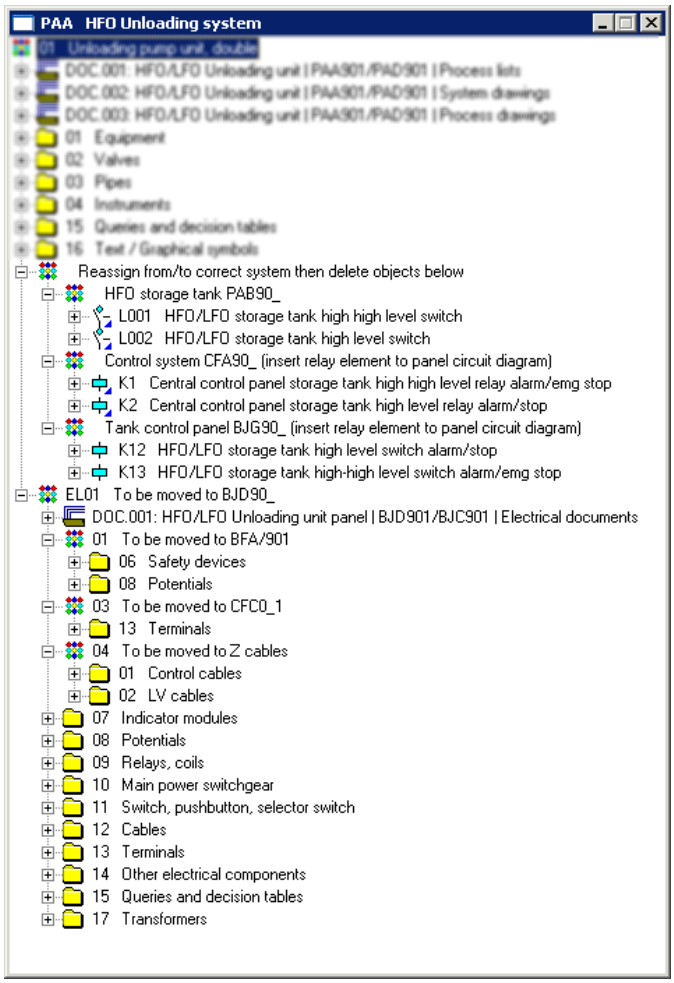

Figure 10 shows example of Electrical structure

Electrical Document Package contains Electrical drawings and lists (Figure 11).

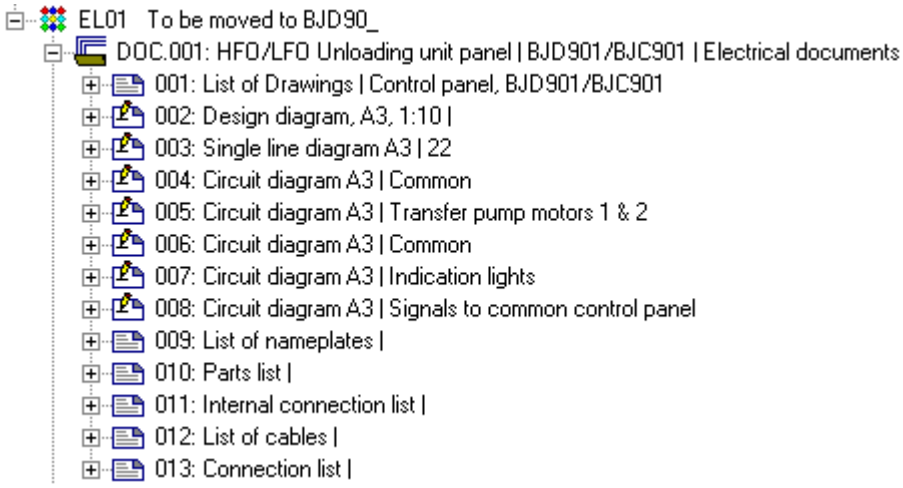

Figure 11 shows example of Electrical Document package structure

8 UNITS

8.1 Unit Properties

Base units 01 and 02 Descriptions are inherited from upper level and they are filled automatically in Descriptions area. An alternative unit Descriptions comes from Decision Table. Label field should leave empty.

If unit contains Decision Table and alternative units are created, there should be different numbering (*0101, 0102* etc) for those units. In that case, specifications in Name field are more detailed e.g. *0101 HFO Unloading unit, double 16,2 m³/h* (Figure 12).

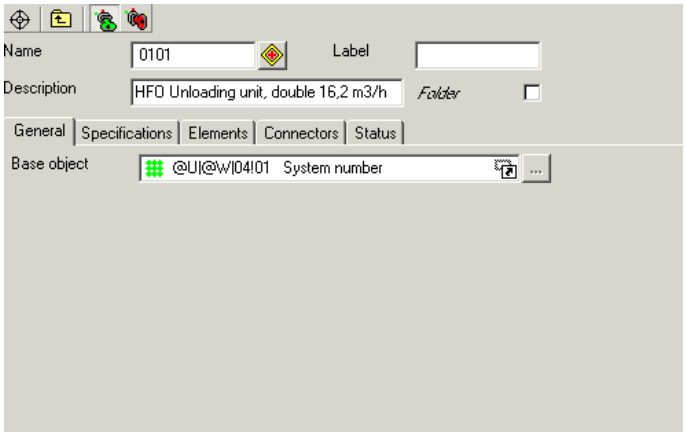

Figure 12 shows Wärtsilä descriptions for 0101 unit

When creating new unit, it's shown as *0x Unit*. This unit name must change manually in unit properties specification e.g. *01, 02* and *0101, 0201 ...* for alternative units. Unit Name in the *Name field* is same as unit name in Comos e.g. *01 HFO/LFO Unloading unit, single* or *02 HFO/LFO Unloading unit, double* etc. (Figure 13). That information should place to Description field.

Comos create automatically space before Name field and its must keep there.

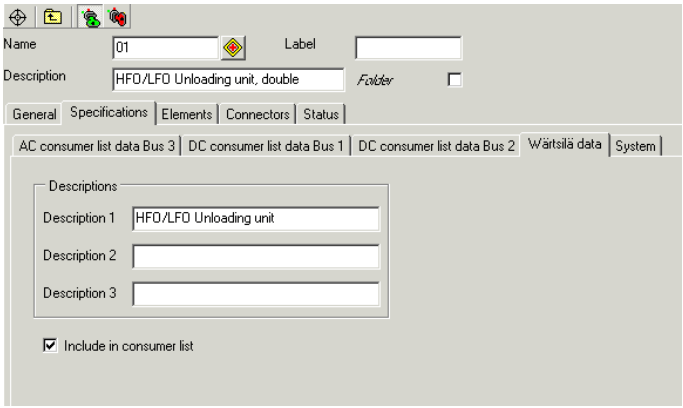

Figure 13 shows Wärtsilä descriptions for 01 unit

9 DEVICE SPECIFICATIONS

Device specifications for Engineering Objects are specified table below (Table 1).

Pure Description	With attribute(s) SLI	With attribute(s)	Attribute(s)
Induction motor	Yes	Yes	TD.ETS1018 - Current TD.ETS1069 - Current
Indication light	No	Yes	TD.ETS1024 - Color
Relay, slow operating	No	Yes	TD.ETS1031 – Delay time
Circuit breaker	Yes	Yes	TD.ETS1057 – Breaking capacity
Switch-disconnector	Yes	Yes	TD.ETS1069 – Current (Amp)
Motor protec-	Yes	Yes	TD.ETS1080 – Thermal

tion switch			overload release
Control volta-ge transformer	Yes	Yes	TD.ETS1111 - Voltage; TD.ETS1128 - Ampere; TD.ETS1129 - Effect;

Table 1 show the example of attributes and descriptions for engineering objects

9.1 Third part units

For *third part units* the amount of documents is decreased (Figure 15).

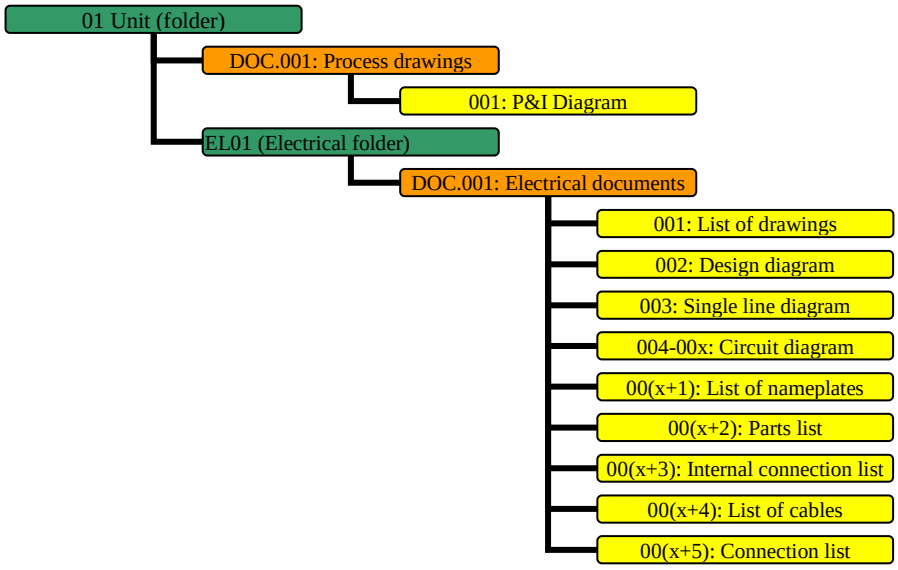

Figure 15 show example of 3 rd part unit structure

9.2 Document package properties

The objects are divided into *document packages* and *document templates* (Figure 16).

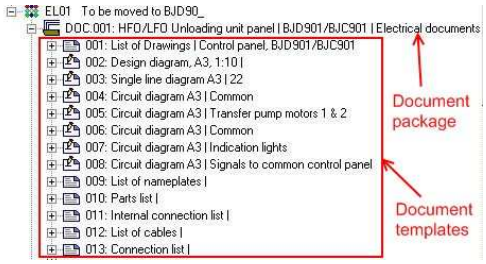

Figure 16 show location of document package and document templates

It is very important that the document object properties are specified correctly to get the correct information to the title boxes & DMS (document management system).

9.3 Document package properties descriptions

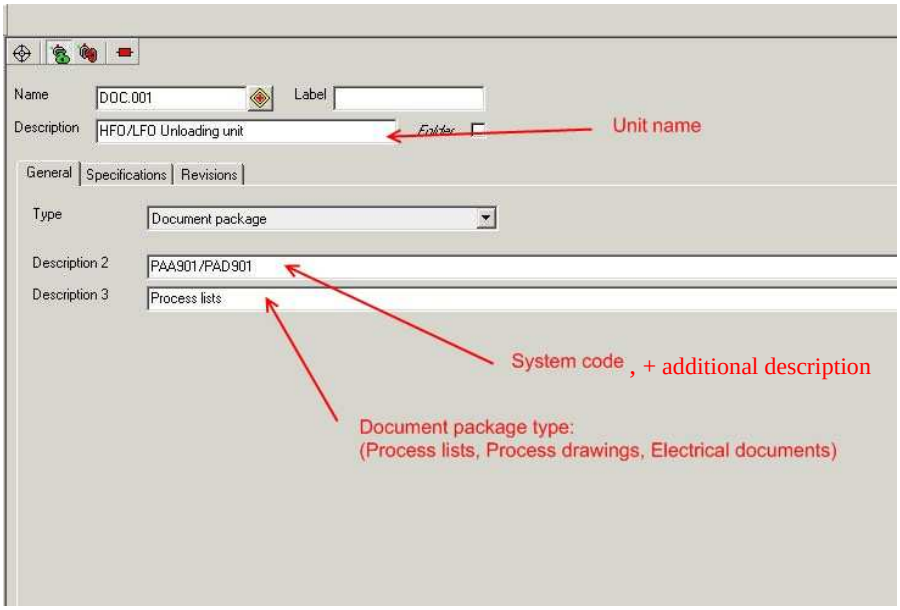

Figure 17 show how to fill correctly document package properties

Notice that “panel” should be added to the E*lectrical documents* doc. package e.g. *HFO/LFO unloading unit panel* (Figure 17).

Filling properties correctly is shown below (Figure 18).

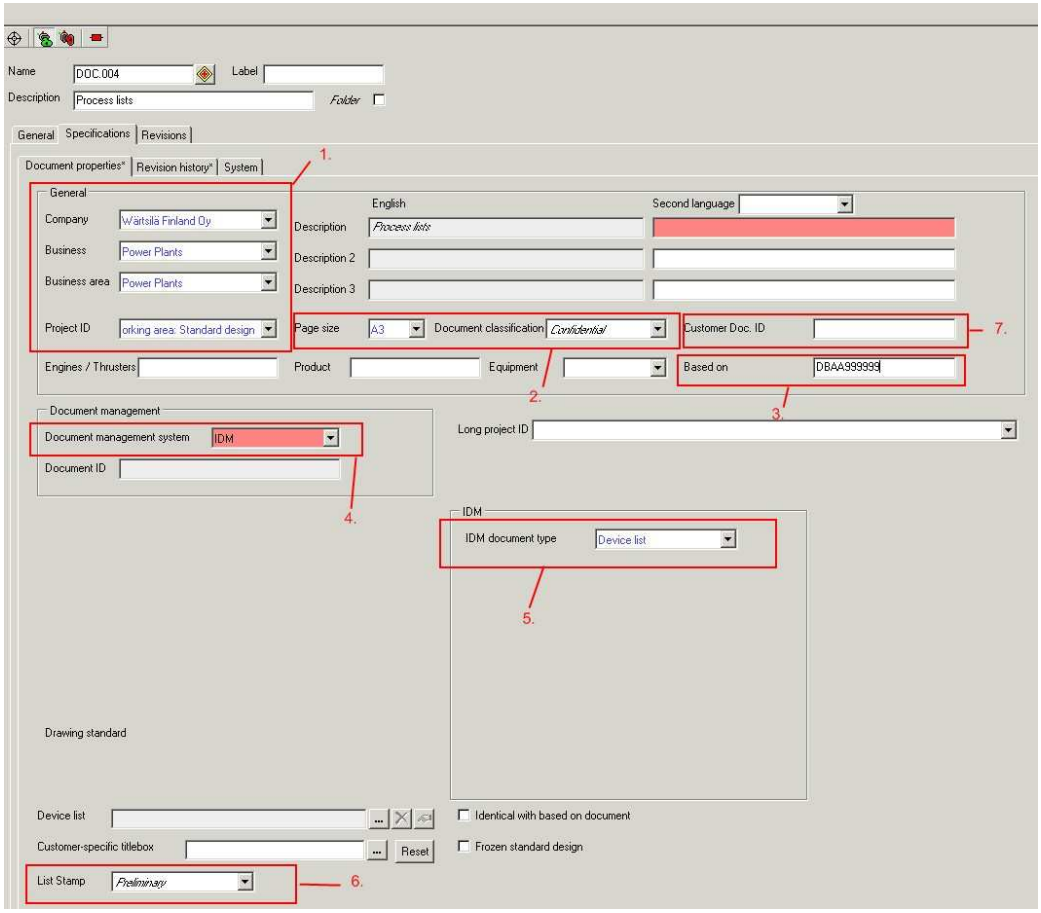

Figure 18 show how to fill properties correctly

1. The correct company and project information from the selection boxes must be filled.

2. Classification to confidential and select page size. The page size will be written to IDM when getting document ID. This will cause some issues with the *electrical drawings* document package, because it usually includes drawing & list templates with differing page sizes. The electrical documents are generated into one .pdf file which might make it problematic to print the pages to correct sizes.

3. If a reference list/drawing has been used for creating a unit, insert it into the based on field.

4. DMS must be selected.

5. IDM document type tells needed data for proper document handling. For *process lists* device list tells which type is it.

6. The list stamp attribute that will appear in all templates telling which kind of list are wanted. Before sending the drawings/lists to DMS, must be checked that this is changed to “no stamp”.

7. If the unit is a third part unit, reference document in the Customer doc ID field must specified. This will make it easier to keep track of which reference documents have been used for creating the unit in Comos.

It is not necessary to fill in all the data for the *system drawings* document package, since it will not be sent to DMS. The data (Figure 19) should anyhow fill to get needed data shown in the navigator window.

9.4 Document template properties

Some attributes in the template objects will be shown in the title boxes. There are two categories that have different properties. The first category involves all the *process documents* and the electrical *list of drawings* (Figure 17).

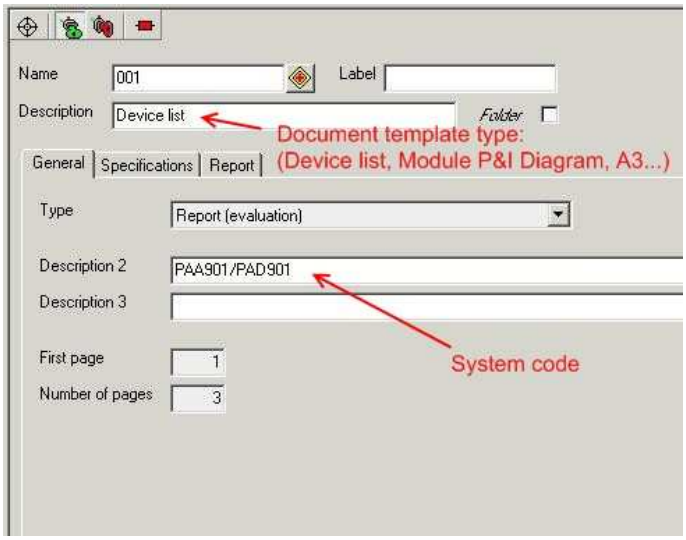

Figure 19, Category 1, Process documents & Electrical ‘List of drawings’

The correct template type will usually appear in the description field when creating a document. An exception is the device list that should be renamed from “Device list, Power Plants” to simply “Device list”.

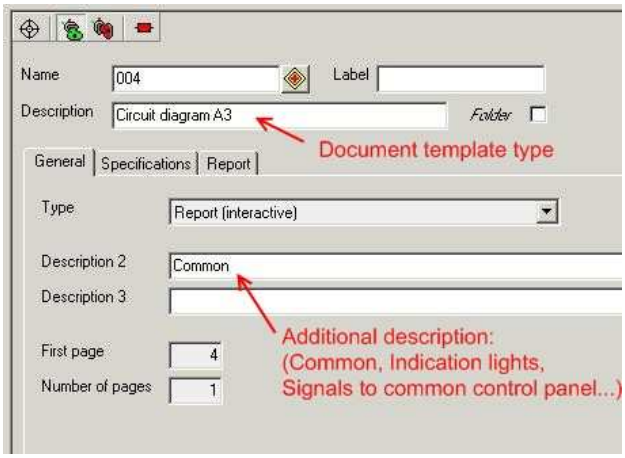

Figure 20, Category 2, Electrical documents except 'List of drawings'

The description 2 is used as *'additional description'*. The field should be left empty if no additional description is needed.

The data in the specification tab is inherited. Usually nothing should be written to this tab. The *electrical documents* might contain some template specific data that needs to be filled in (Figure 20).

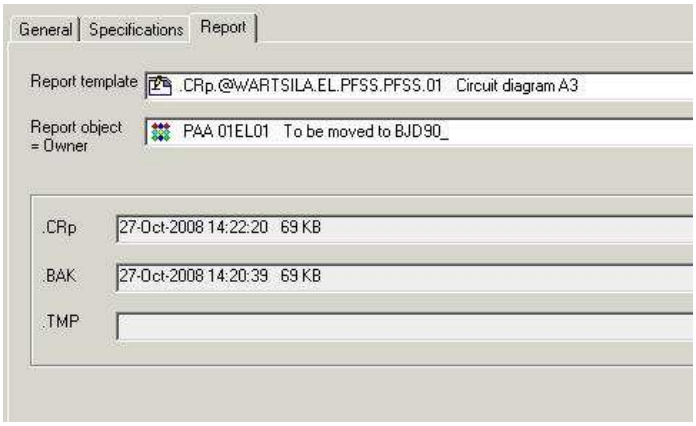

Figure 21 show example of filled Report sheet

The report objects (Figure 21) must be set as following:

- P*rocess drawing templates*, the unit folder.
- *Device list template*, the Module P&I Diagram.
- *Electrical document templates*, the EL01 folder.

10 TITLE BOX

10.1 Title box settings

Before uploading drawing to IDM, title box has to be filled. Descriptions and based on shows directly in title box (Figure 22).

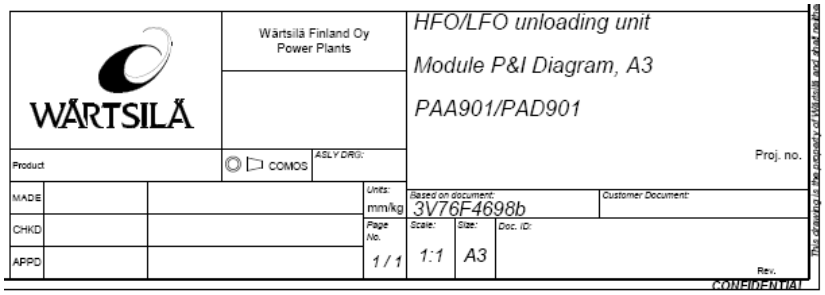

Figure 22 show correctly filled title box

After uploading to IDM there is Doc. ID, which is generated automatically when it's moved to the S01. Project number and Project name can choose in Document Package properties and it become as WFI-P STD (Figure 23).

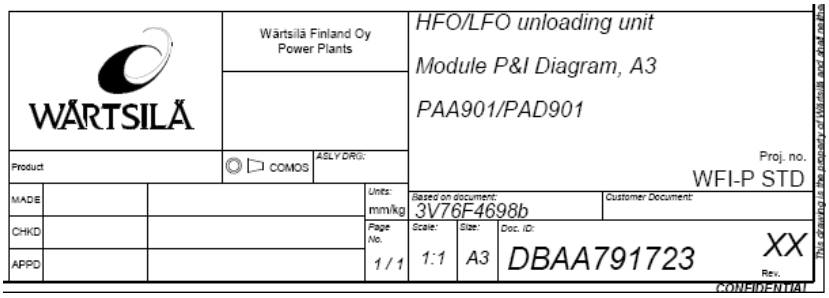

Figure 23 show how standard name is shown in title box

After uploading to IDM, it's creating correct specifications to the right place (Figure 24).

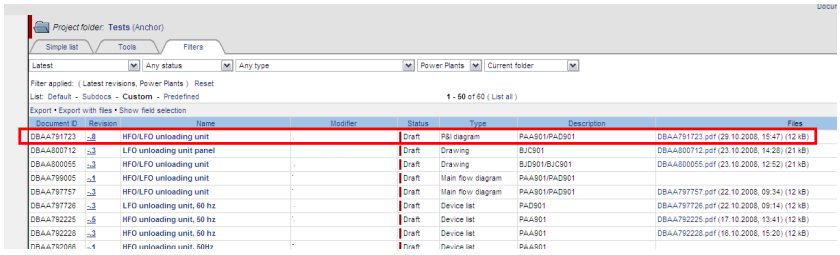

Figure 24 Typical view of IDM structure

10.2 Device list title box

Before uploading Document package to IDM, title box have 3 Descriptions and based on to be filled (Figure 25).

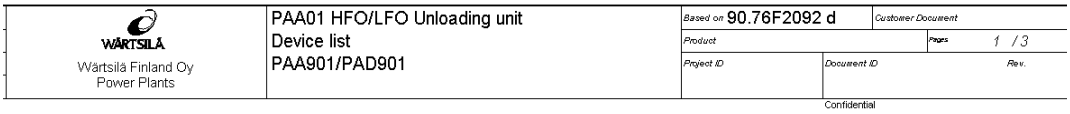

Figure 25 show example of filled Device List title box

11 DECISION TABLES

11.1 Structure

Each unit have specific Decision Table, 3 Electrical tables and 3 Mechanical Action Tables (Figure 26).

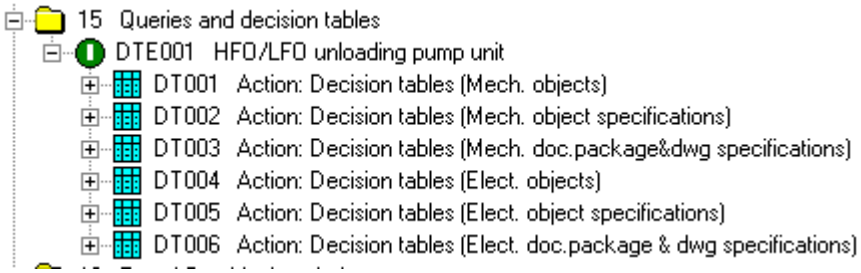

Figure 26 show decision table in Comos

12 DEVICE LISTS

12.1 Device list properties and descriptions

Device list properties generate automatically 00x number, which should keep there. If there is something else, it must be generated with button next to Name field. Description area is always *Device list* (Figure 27). Description 2 must be filled as PAA901/PAD901, because Device Lists are used in multiple units. Report template type depend Business place. E.g. Power Plant uses *9104*. Figure 28 shows how Descriptions shown in structure.

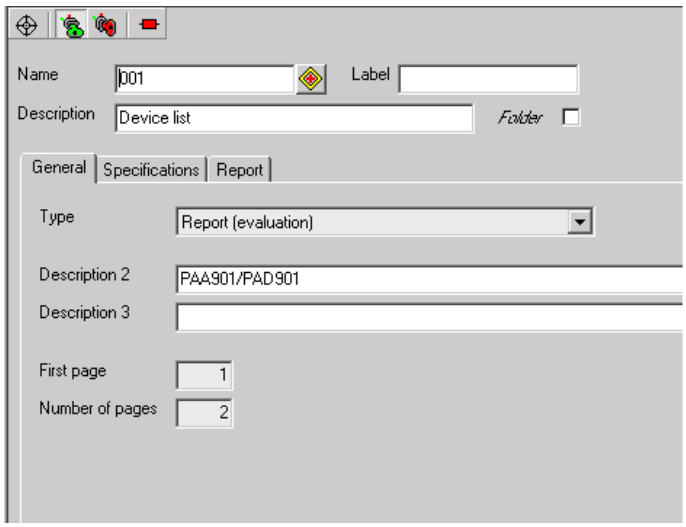

Figure 27 show Device List properties sheet

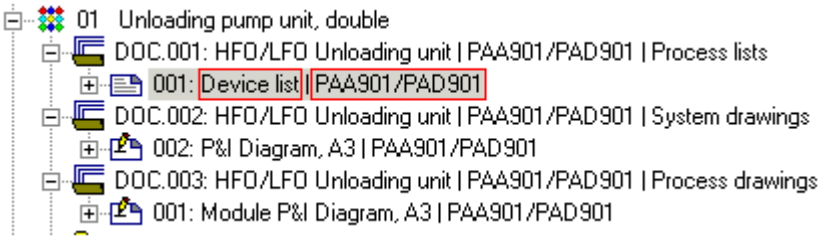

Figure 28 shows how Descriptions shown in structure.

13 CONCLUSION

Explanations:

Comos = the engineering tool CIS = Comos Industrial Solutions, software supplier.

13.1 Software & Database

An issue is how to deal with the Comos software & database in the future. Scenario could be that Power Plants will have about 150 projects ongoing simultaneously, and Ship Power will be contributing with *n* pcs of projects to the same database. Every year a new software version is released, and every month a service pack. Every update contains risks and can be disastrous in case data will be lost or the database would be damaged.

Wärtsilä have during this evaluation project also noticed that drawings have changed after a new service pack has been installed. This risk isn't that valid for "normal" software that store data in files (e.g. Excel, Word, ACAD). This can not endanger the delivery projects.

Example database delivered (business) → Database customization by customers → New software version release by CIS → Customer to update database & software → CIS: "We don't know your database" - Need of analysing customers database (business) → CIS to update software version (business).

CIS policy is to support the latest two software versions. This, more or less, forces Comos customers to upgrade their software, in case CIS support is desired. To be able to do software updates, the database should be modified as little as possible. The problem is that the standard database delivered with Comos is only an "exam-

ple database" so company specific customization has to be done (to be able to do delivery projects).

The latest version of Comos was released in beginning of 2009. A frightening fact is that not a single "old Comos customer" has upgraded to Comos 9 Vega at the time being, June 2009. Is it at all possible to update software versions, how long will it take and what will it cost?

When reading specific features in the Comos manual and asking advices about the functionality or how it can be used, user usually end up with the answer: "It is not included in your Comos module and you need another licence". Usually isn't sure what is included in the delivered software licenses. The license policy is rather woolly and needs to be discussed on management level.

The support model is a big question mark. The general experience is that "Out of the box" Comos is an "idea" instead of a "ready to use product". Most modification requires customization, and CIS isn't taking responsibility of the delivered "example database" and isn't e.g. willing to correct and add missing symbols to the database.

13.2 Suitability

An assumption is that many Comos customers around the world are working with "Process from scratch" methods. Every project is rather unique, and this company probably sells 2-10 projects / year, and the delivery time is several years.

The design stage starts already in the sales phase and is ongoing for 1 year. The company first specifies an overall process view, the *process flow diagram.* The PFD remains as the plant overview diagram. The detail design is made as piping and instrumentation diagrams. P&IDs mainly consist of:

1. Piping

2. Equipment

3. Lines and instruments used to monitor and control the process.

The rule of thumb is that one P&ID contains 1-3 main equipment with auxiliaries. One plant may be drawn as hundreds of P&IDs. This way of working probably suits Comos well. This is not fulfil Wärtsilä Power Plants way of working, mainly due to advanced standardisation and modularisation.

Comos can also be used as a PDM system in case the company has no other PDM system in used. This might be rather suitable for small customers. Comos would probably be working quite well in this situation since you could have the materials in one database inside the engineering tool and keep them up-to-date. This will not be the case for Wärtsilä.

13.3 Way of working

It is unclear how to do projects efficiently in Comos i.e. reusing design. Units and modules can be created and placed as templates to the system. It isn't sensible to copy old projects. Not possible to copy a system or part of a system as in a Cad-tool, since you will loose connections to the electrical drawings and one main idea with Comos will be lost. More suitable way of working is e.g. to print out paper copies of old projects, and copy them "manually" to Comos.

Comos requires that everything, more or less, must be done to 100% i.e. it is difficult to "cheat". This also means that user need a lot of input before the design, and changing big parts of a system afterwards might be time consuming and problematic. A challenge will be the "equipment deliveries", since Power Plants need to show some details from the customer scope that might not be available at the time needed. The same case will occur with connections from local control panels to electrical cabinets designed by sub-suppliers.

The time used for creating design will increase with Comos in comparison to IDOK & ELSA. How much depends on the quality and availability of standard design. The levels of engineering will more or less be swept away, and everything will be "detailed design".

Comos is a very complex tool and it is difficult to keep it simple. Taking Comos into use would require committed fulltime users.

At first "Wärtsilä Comos" was designed to have an object library on material level. This idea was swept away with this evaluation project by instead having general objects.

13.4 Documentation output

The output from Comos can probably meet Wärtsilä requirements, in case CIS can fix all the technical issues raised. For the mechanical & process discipline the P&IDs (flow diagrams) can be drawn. Queries and reports can be generated and exported. The assumption is that device lists should be drafted from an engineering/design tool on "general object level". This list could then be used to generate material to the delivery project in Teamcenter.

13.5 Devices

The device library will be a big challenge, since the delivered library is only an example of best practices. This will require creation of new objects for both electrical and process disciplines. The device creation on material level failed in the current production database. The electrical objects are the challenging ones as they are often built as a main component with elements (e.g. relay with auxiliary contactors). The objects may be combinations of graphical symbols, standard tables and scripts. These types of devices must be created by experts to support the software correctly.

An object consists of attributes and the attributes are placed on different tabs (e.g. technical data, process data, substance data etc.). A problem is that different kinds of objects have a different setup of tabs and attributes due to as earlier mentioned the "example database". This means that some device groups don’t have a process data tab, only electrical devices have an order data tab and so on. It is difficult to compare the devices / device groups to each other, and sometime even hard to find the correct places to fill in the data. This might lead to customization for harmonizing (with all its possible drawbacks).

13.6 Result

In late 2009 Comos team realize that Comos wasn't what Wärtsilä was looking for. Comos is "make it yourself" kind of program. That mean the program is simple as possible and customer make it suitable for their needs.

Comos project was ended in the beginning of 2010. Wärtsilä Ship Power desired still continues with that program because it seems like it is good product for them at this point.

Also costs were one of the reasons to stop working with Comos. In 2009 and beginning of 2010 there is much more choices for making that kind of work compared to year 2003 when Comos project was started.

Wärtsilä desired to continue with Autodesk P&I Mechanical and Electrical programs. The solution is not the best because those are separate programs. But in otherwise Autodesk products are familiar for employers in Wärtsilä and will be easier to use them. Also the existing databases are easier to modify for Wärtsilä needs because Autodesk products are widely used in Wärtsilä.

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